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EXAMINER

WEBB, GREGORY E

ART UNIT	PAPER NUMBER
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1751

DATE MAILED: 06/23/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

✓

Office Action Summary	Application No. 10/750,248	Applicant(s) NAM, SANG WOO	
	Examiner Gregory E. Webb	Art Unit 1751	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 052506.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) 1-8 and 17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 9-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>1005</u> . | 6) <input type="checkbox"/> Other: _____ |

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Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Jolley, Michael K. (US5489557).

Concerning the DIW, Jolley, Michael K. teaches the following:

The repeated alternating treatments with the oxidizing agent-base and oxide removal agent are preferably separated by intervening or intermediate rinsing steps. These intervening rinsing steps are preferably accomplished using a suitable diluent or solvent, more preferably a solvent which can help to carry away loosened particles. The solvent or other

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diluent is preferably selected to be a common diluent or solvent present in both the oxidizing agent-base treatments and oxide removal treatments. Most preferably the rinsing is accomplished using purified **water**. The purified **water** is preferably **deionized water** of high resistivity, or distilled and **deionized water** of high resistivity, such as 10 megohms or greater resistivity. The use of intervening **water** or other rinses arrests or inhibits the oxidation and effects of the base. The rinses also inhibit or arrest the action of the oxide removal agent when performed after such processing. The rinsing steps are preferably accomplished at room temperatures, 15.degree.-25.degree. C., for periods of approximately 30 seconds to 5 minutes, more preferably 1-3 minutes, even more preferably approximately 2 minutes. (*emphasis added*)

Concerning the H.sub.2SO.sub.4 and the H.sub.2O.sub.2, Jolley, Michael K. teaches the following:

It has previously been typical for silicon wafers to be processed using a method commonly referred to as the "RCA clean". In this process the silicon wafer, substrate, or other item is first cleaned with an aqueous solution of **sulfuric acid** and **hydrogen peroxide** to remove organic contaminants. This is followed by treatment with an aqueous solution of ammonium hydroxide and **hydrogen peroxide**. After this the wafers are rinsed with deionized water. (*emphasis added*)

Concerning the HF, method for removing polymer and the protective oxide film, Jolley, Michael K. teaches the following:

The RCA clean also typically involves **stripping** the silicon dioxide layer formed in the previous steps using an aqueous **hydrofluoric acid** solution. The **hydrofluoric acid** solution removes the silicon dioxide layer leaving bare silicon. The bare silicon demonstrates the property of not being easily wetted and is frequently referred to as being "hydrophobic". This should be contrasted with the silicon dioxide surface existing prior to this step, which is easily wetted and the wafer is commonly called "hydrophilic". (*emphasis added*)

Concerning the post-etching process, Jolley, Michael K. teaches the following:

The concentration of the base is also related to the concentration of the oxidation agent. The oxidation agent provides cleaning properties and promotes oxidation of the semiconductor surface. If the base acts as an **etchant**, such as ammonium hydroxide does against silicon, then the oxidation agent must be in sufficient concentration to provide an oxidation rate of the semiconductor material which produces a net growth rate against the rate of **etching** caused by the base. In the preferred oxidation agent-base mixtures for silicon comprising water, hydrogen peroxide, and ammonium hydroxide, the ratios are in the range of approximately 10:1:1 to approximately 100:1:0.1. (*emphasis added*)

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Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Bran, Mario E. (US5950645).

Concerning the DIW, Bran, Mario E. teaches the following:

The rinse sequence is very fast (20 seconds for each fill) inasmuch as the high flow cold DI **water**, a quick fill of fine manifold flush, and the spray are functioning. Thus, DI **water** is flowing at a rate of approximately 48 liters per minute, and a 16-liter tank is quickly filled to a level to cover the wafers in approximately 20 seconds. The actual time is dependent on **water** pressure which varies considerably. Much less **water** is used than that in conventional rinsing, since only 3-5 seconds of overflow is used as compared to other systems, wherein **water** flows through the system for a much longer period of time. Deionized **water** is sprayed on the wafers by means of spray nozzles to prevent contaminants from settling on the wafer while **deionized water** is being introduced from below. The spray preferably provides relatively large droplets as opposed to mist. This is important to reduce the potential of electrostatic discharge associated with high resistivity (18.2 megohm cm.sup.-1) DI **water** spray systems. (*emphasis added*)

Concerning the H.sub.2SO.sub.4, H.sub.2O.sub.2, HF and the method for removing polymer, Bran, Mario E. teaches the following:

The chemistry used in the Vc1 cycle replaces the use of hot **sulfuric acid** and **hydrogen peroxide**, commonly referred to as "Piranha," and acts to remove light to medium organic residues and particulates prior to a step employing **hydrofluoric acid**. The Piranha treatment may still be needed initially for the **stripping** of wafers having heavy organic deposits such as photoresist. (*emphasis added*)

Concerning the post-etching process, Bran, Mario E. teaches the following:

Still the most commonly used cleaning solutions are those developed by RCA many years ago employing hydrogen peroxide chemistry, particularly those referred to as "standard clean 1" or "SC-1" and "standard clean 2" or "SC-2." SC-1 typically comprises ammonium hydroxide, hydrogen peroxide and deionized water in the following ratios: 1 NH.sub.4 OH: 1 H.sub.2 O.sub.2 : 5 H.sub.2 O. SC-2 usually comprises 6 H.sub.2 O: 1 H.sub.2 O.sub.2 : 1 HCl. Typically wafers are immersed in these solutions for 10 minutes at 25.degree.-80.degree. C. for each solution. Intermediate and final rinses of deionized water are used between chemical steps. If the wafers are particularly contaminated, there is an initial cleaning step utilizing a solution known as "Caros" or "Pirhana," typically comprised of H.sub.2 SO.sub.4 and H.sub.2 O.sub.2 in ratios varying from 2-5:1. Following the use of Pirhana there is frequently an

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additional **etching** step employing DHF (dilute hydrofluoric acid).
(*emphasis added*)

Concerning the protective oxide film, Bran, Mario E. teaches the following:

The testing was conducted at Balazs Analytical Laboratory, in Sunnyvale, Calif. The silicon wafer was placed in a box saturated with HF vapor and the **oxide layer** on the wafer is allowed to react with the HF vapor. Then, the trace metallic impurities on and in the oxide are collected with a small amount of ultrapure acid. The solution is analyzed for trace metals by Flow Injection ICP-MS. In the analysis, the metallic atoms are actually being counted, and the results shown are in units of 10.sup.10 atoms per cm.sup.2 of surface area. Sample preparation steps were carried out in a clean room environment to minimize contamination. (*emphasis added*)

Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by CLARK, R. SCOT (US20010051128).

Concerning the DIW and the HF, CLARK, R. SCOT teaches the following:

[0112] At deglaze station 434, dilute aqueous **HF** or dilute buffered-**HF** is applied to the wafer, for example, to remove a native or other oxide film. The dilute buffered-**hydrofluoric** acid can be supplied using a system as described above. For example, the buffered-**HF** can be supplied directly, through sealed piping, from generator 436. **HF** reservoir 438 holds anhydrous **HF**, from which a stream of gaseous **HF** is fed through ionic purifier 440 into the generator. To provide a buffered solution, gaseous ammonia can be bubbled into generator 436 and ultrapure **deionized water** can be added to achieve the desired dilution. This is followed by a rinse in ultrapure **deionized water** at station 442, and drying at station 444. (*emphasis added*)

Concerning the H.sub.2SO.sub.4, H.sub.2O.sub.2 and the method for removing polymer, CLARK, R. SCOT teaches the following:

[0108] FIG. 4 illustrates exemplary wafer cleanup stations in a conventional line 400 for semiconductor fabrication. The first unit in the cleaning line is a photoresist **stripping** station 402, in which aqueous **hydrogen peroxide** 404 and **sulfuric acid** 406 are combined and applied to the semiconductor surface to strip off the resist. This is followed by a rinse station 408, where deionized water is applied to rinse off the **stripping** solution. (*emphasis added*)

Concerning the post-etching process, CLARK, R. SCOT teaches the following:

[0025] The reaction of HF with silicon produces fluosilicic acid, a strong acid which shifts the pH of the **etching** solution and hence the **etch** rate.

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As a result, hydrofluoric acid is often used in buffered form (Buffered-HF or BHF), to reduce shifts in pH as the acid solution becomes loaded with **etching** by-products. In buffered-hydrofluoric acid, the buffering in the acid solution is usually provided by an ammonium component, such as ammonium fluoride (NH₄F). (*emphasis added*)

Concerning the protective oxide film, CLARK, R. SCOT teaches the following:

[0010] One of the long-running technological shifts in semiconductor processing has been the changes (and attempted changes) between dry and wet processing. In dry processing, only gaseous or plasma-phase reactants come in contact with the wafer or wafers being treated. In wet processing, a variety of liquid reagents are used for a multitude of purposes, such as the etching of silicon dioxide, silicon nitride and silicon, and the removal of native **oxide layers**, organic materials, trace organic or inorganic contaminants and metals. (*emphasis added*)

Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Liu, Lewis (US20020033186).

Concerning the DIW, Liu, Lewis teaches the following:

[0007] The use of ozone for removing organic material, such as photoresist, from semiconductor wafers has been investigated. For example, U.S. Pat. No. 5,464,480 issued to Matthews (hereinafter "Matthews"), describes a process in which semiconductor wafers are contacted with a solution of ozone and **water** at a temperature of about 1.degree. C. to about 15.degree. C. Matthews discloses, for example, placing the semiconductor wafers into a tank containing **deionized water**, diffusing ozone into the **deionized water** for a time sufficient to oxidize the organic materials from the wafers, while maintaining the temperature of the **water** at between about 1.degree. C. to about 15.degree. C., and then rinsing the wafers with **deionized (DI) water**. Matthews further discloses exposing the wafers to ultraviolet light during the process. (*emphasis added*)

Concerning the H₂SO₄, H₂O₂ and the HF, Liu, Lewis teaches the following:

[0061] The optional reactive chemical process fluids useful in the present invention contain one or more chemically reactive agents to achieve the desired surface treatment. Preferably, the concentration of such chemically reactive agents will be greater than 1000 ppm and more preferably greater than 10,000 ppm, based on the weight of the reactive chemical process fluid. However, in the case of ozone, generally the concentration is equal

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to or greater than about 10 ppm and more preferably from about 10 ppm to about 50 ppm. Examples of chemically reactive agents include for example hydrochloric acid or buffers containing the same, ammonium hydroxide or buffers containing the same, **hydrogen peroxide**, **sulfuric acid** or buffers containing the same, mixtures of **sulfuric acid** and ozone, **hydrofluoric acid** or buffers containing the same, chromic acid or buffers containing the same, phosphoric acid or buffers containing the same, acetic acid or buffers containing the same, nitric acid or buffers containing the same, ammonium fluoride buffered **hydrofluoric acid**, deionized water and ozone, or combinations thereof. (*emphasis added*)

Concerning the method for removing polymer, Liu, Lewis teaches the following:

[0023] There have been several attempts over the last years to use ozone (O.sub.3) for bulk photoresist **stripping**. However, the use of ozonated process fluids (e.g., ozonated deionized water) has traditionally suffered from unsatisfactorily low etch rates. (*emphasis added*)

Concerning the post-etching process, Liu, Lewis teaches the following:

[0063] Examples of preferred reactive chemical process fluids useful in the present invention include cleaning fluids, **etching** fluids, and photoresist removal fluids. Cleaning fluids typically contain one or more corrosive agent such as an acid or base. Suitable acids for cleaning include for example sulfuric acid, hydrochloric acid, nitric acid, or aqua regia. Suitable bases include for example, ammonium hydroxide. The desired concentration of the corrosive agent in the cleaning fluid will depend upon the particular corrosive agent chosen and the desired amount of cleaning. These corrosive agents may also be used with oxidizing agents such as ozone or hydrogen peroxide. Preferred cleaning solutions are "APM" solutions containing water, ammonia, and hydrogen peroxide, and "HPM" solutions containing water, hydrogen peroxide, and hydrochloric acid. Typical concentrations for HPM solutions range from about 5:1:1 to about 200:1:1 parts by volume H.sub.2O:H.sub.2O.sub.2:NH.sub.4OH. Typical concentrations for APM solutions range from about 5:1:1 to about 1000:0:1 parts by volume H.sub.2O:NH.sub.4:HCl. Suitable **etching** solutions contain agents that are capable of removing oxides. A common **etching** agent used is for example hydrofluoric acid, buffered hydrofluoric acid, ammonium fluoride, or other substances which generate hydrofluoric acid in solution. A hydrofluoric acid containing **etching** solution may contain for example from about 4:1 to about 1000:1 parts by weight H.sub.2O:HF. One skilled in the art will recognize that there are various process fluids that can be used during wet processing. Other examples of process fluids that can be used during wet processing are disclosed in "Chemical Etching" by Werner Kern et al., in Thin Film Processes, edited by John L. Vossen et al., published by Academic Press, NY 1978, pages 401-496, which is incorporated by reference in its entirety. (*emphasis added*)

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Concerning the protective oxide film, Liu, Lewis teaches the following:

[0039] There are various process fluids used during wet processing. Generally, the most common types of process fluids used during wet processing are reactive chemical process fluids or liquids, and rinsing fluids or liquids. The terminology "reactive chemical process fluid" or "reactive chemical process liquid" as used herein, is any liquid or fluid that reacts in some desired manner with the surfaces of the electronic components to alter the surface composition of the electronic component. For example, the reactive chemical process liquid or fluid may have activity in removing contamination adhered or chemically bound to the surfaces of the electronic components, such as particulate, metallic, photoresist, or organic materials; activity in etching the surfaces of the electronic component; or activity in growing an **oxide layer** on the surface of the electronic component. As used herein, "rinsing liquid" or "rinsing fluid" refers to DI water or some other liquid or fluid that removes from the electronic components and/or processing chamber residual reactive chemical process fluids, reaction by-products, and/or particles or other contaminants freed or loosened by the chemical treatment step. The rinsing liquids or fluids may also be used to prevent redeposition of loosened particles or contaminants onto the electronic components or processing chamber. Examples of reactive chemical process fluids and rinsing fluids useful in the methods of the present invention are described in more detail hereinafter. (*emphasis added*)

Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Ramachandran, Ravikumar (US6630074).

Concerning the DIW, H.sub.2SO.sub.4, H.sub.2O.sub.2, HF and the post-etching process, Ramachandran, Ravikumar teaches the following:

The **etchant** compositions of the present invention are aqueous solutions containing about 0.01 to about 15 percent by weight and preferably about 1 to about 10 percent by weight of **sulfuric acid** and about 0.01 to about 20 percent by weight of **hydrogen peroxide**, 0.1 to about 100 ppm of **hydrofluoric acid** and preferably about 1 to about 10 percent by weight of **hydrogen peroxide** or about 1 to about 30 ppm and preferably about 5 to about 20 ppm of ozone with the balance being substantially **water**, and more preferably contain about 0.1 to about 100 ppm of a fluoride containing compound, preferably **hydrofluoric acid**. It is not necessary that the fluoride containing compound be **hydrofluoric acid**. It is necessary that the fluoride containing compound contribute free fluoride to the **etchant** composition. It is preferred that the fluoride containing compound be able to contribute the equivalent of at least about 8 and at most about 12 ppm of **hydrofluoric acid** to the **etchant** solution. A

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preferred composition of the present invention is an aqueous solution of about 8 percent by weight of **sulfuric acid**, and about 1.5 percent by weight of **hydrogen peroxide** and the remainder being substantially **water**, and more preferably contain about 10 ppm of a fluoride containing compound, preferably **hydrofluoric acid**. This composition is preferably employed at temperatures of about 35.degree. C. Another more preferred composition of the present invention is an aqueous solution of about 9 percent by weight **sulfuric acid** and about 4 percent by weight **hydrogen peroxide** and the remainder being substantially **water**, and more preferably contain about 10 ppm of a fluoride containing compound, preferably **hydrofluoric acid**. This composition is preferably employed at temperatures of about 35.degree. C. and is especially preferred for removing thicker and more tenacious sidewall polymer. Yet another more preferred composition of the present invention is an aqueous solution of about 5% by weight of **sulfuric acid**, about 12% by weight of **hydrogen peroxide** and about 10 ppm hydrogen fluoride. The **water** employed is preferably **deionized water**. (*emphasis added*)

Concerning the method for removing polymer, Ramachandran, Ravikumar teaches the following:

An aqueous etchant composition containing about 0.01 to about 15 percent by weight of sulfuric acid and about 0.01 to about 20 percent by weight of hydrogen peroxide or about 1 to 30 ppm of ozone, and about 0.01 to 100 ppm of hydrofluoric acid is effective in **removing polymer** and via residue from a substrate or conductive material, and especially from an integrated circuit chip having aluminum lines thereon.

(*emphasis added*)

Concerning the protective oxide film, Ramachandran, Ravikumar teaches the following:

Additionally, after a RIE process, sidewall polymers remain on the semiconductor wafer surface. These sidewall polymers, known as "polymer rails" are inorganic in nature and have various chemical constituents, including aluminum, silicon, titanium, oxygen, carbon and chlorine. Since each of these constituents tend to react and/or interfere with the semiconductor wafer function, removal of the sidewall polymers is therefore desirable. A post metal RIE cleaning step is presently done using a chromic/phosphoric acid etch, or solvent based chemistry methods. However, one common chemical constituent with a solvent based chemistry is an amine which can cause problems with certain types of photoresists. Solutions which are based on diluted sulfuric acid and hydrogen peroxide mixtures have been introduced in an attempt to remove polymer rails. However, these methods have not been successful in removing all types of polymer rails. For example, as shown in FIG. 1, in regions where there is an isolated metal pad which has a metal line density lower than the array region of the semiconductor chip and a surrounding

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region which is predominantly silicon oxide, current methods are less than completely successful. FIG. 1 illustrates a situation where the use solution of the present invention would be indicated. In FIG. 1, a wafer is shown after it has undergone a RIE process. The direction of the RIE process is shown by the arrow. The structure shown, 10, can be comprised of multiple layers. For example, there can be an **oxide layer**, 11, and a conductive layer, 12. The RIE process selectively removed portions of the conductive layer to expose the **oxide layer**. Accordingly, there is little to no residual left on the surface, 5, of the oxide, 11. The RIE process was, in this case, directed at the surface, 5, as shown by the arrow. However, the structure, 10, may contain a solid film, 15, covering the sidewalls, 13 and the top, 14, of the structure, 10. (*emphasis added*)

Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Berry, Ivan (US6630406).

Concerning the DIW, H.sub.2SO.sub.4, H.sub.2O.sub.2, HF and the method for removing polymer, Berry, Ivan teaches the following:

After exposure to the oxygen-free and nitrogen-free plasma, the wafers may be exposed to a **peroxide** rinse or a **deionized water** rinse or a wet **stripper** to remove any photoresist, polymer and residues remaining on the wafer. Wet **strippers** include acids, bases and solvents as is known to those skilled in the art. The particular wet **strippers** used are well within the skill of those in the art. For example, nitric acid, **sulfuric** acid, ammonia, **hydrofluoric** acid are commonly employed as wet **strippers**. In operation, the wet **stripper** is immersed, puddled, streamed, sprayed or the like onto the substrate and subsequently rinsed with **deionized water**. It has been found that the use of wet **strippers** is a fairly easy and inexpensive test to determine if the ashing plasma affects the chemical, electrical or mechanical properties of the underlying substrate. (*emphasis added*)

Concerning the post-etching process, Berry, Ivan teaches the following:

Referring now to FIGS. 1A and 1B, trench patterns were **etched** into multiple silicon substrates 10 by an **etcher** using standard **etching** processes. The substrates 10 included a low k dielectric layer 12 and a silicon dioxide layer 14. The patterns were selectively **etched** by use of a patterned I-line photoresist mask. The low k dielectric layer 12 was a carbon-doped oxide commercially available under the trade name CORAL. The substrates were then ashed using a Fusion Gemini ES3 Plasma Asher available from Axcelis Technologies, Incorporated. Processing conditions are set forth in table I. The plasma gas mixture

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contained hydrogen, helium and CF.sub.4 gases. The hydrogen gas was mixed with helium prior to generating the plasma, wherein the percentage of hydrogen gas was 5 percent by volume of the total hydrogen/helium mixture. The ashing process removed substantially all of the photoresist, polymers and post **etch** residues remaining on the substrate after **etching**. Some residue 16 remained on the substrates. (*emphasis added*)

Claims 9-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Yoneda, Kenji (US5896875).

Concerning the DIW, H.sub.2SO.sub.4, H.sub.2O.sub.2, HF and the post-etching process, Yoneda, Kenji teaches the following:

In the above equipment for cleaning, **etching** and drying a semiconductor wafer, the chemical to be used for the cleaning, **etching** or drying is specified. In detail, as the chemical of cleaning solution, mixed solution of aqueous ammonium, **hydrogen peroxide** and **ultrapure water**, mixed solution of hydrochloric acid, **hydrogen peroxide** and **ultrapure water**, mixed solution of **sulfuric acid** and **hydrogen peroxide**, mixed solution of **hydrofluoric acid** and **ultrapure water**, mixed solution of **hydrofluoric acid** and ammonium fluoride, or mixed solution of **hydrofluoric acid**, **hydrogen peroxide** and **ultrapure water** is used. As the chemical of **etching** solution, mixed solution of hydrochloric acid and nitric acid, hydrochloric acid or nitric acid is used. An organic solvent such as isopropyl alcohol is used as a drying solution, and ozonized **ultrapure water** containing ozone of several PPM to 10-odd PPM is used for decreasing roughness of the wafer surface. By such chemicals, the cleaning, **etching** and drying of the semiconductor wafer is appropriately, thoroughly performed. (*emphasis added*)

Concerning the method for removing polymer and the protective oxide film, Yoneda, Kenji teaches the following:

The sequence of supplying HFAC and anhydrous HF may be inverted, wherein steps of rinsing by ultrapure water and of drying the wafer may be required after the treatment with anhydrous HF. The anhydrous HF and the like can be used alone for etching **oxide film** or **removing polymer**. (*emphasis added*)

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Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregory E. Webb whose telephone number is 571-272-1325. The examiner can normally be reached on 9:00-17:30 (m-f).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Douglass McGinty can be reached on (571)272-1029. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Gregory E. Webb
Primary Examiner
Art Unit 1751

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